ADVISORY ASSISTANCE TO THE MINISTRY OF ENERGY OF GEORGIA

WHITE PAPER: Impact of Natural Gas Price Change on Georgia: A First Look

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A First Look[1]

Summary:

Through the end of 2005, the wholesale price of natural gas to Georgia was not over $65 per 1000 cubic meters (1000 cm). It has been announced that from January 1 2006 the price will be $110 per 1000 cm. Part I.A. of this note offers an initial estimate of the impact of that price change on Georgia, based on the differences in price using previously forecasted volumes. Part I.B. then compares those impacts to various national income and economic measures. Part II uses basic concepts of strategic analysis to pose alternatives which can mitigate longer term implications, demonstrating why a more comprehensive analysis of gas strategy is required for Georgia.

Part I.A. Current and Projected Gas Use and Gas Cost in Georgia:

As shown in Tables 1 and 2 below, the present annual gas use in Georgia is estimated as 1.458 million cm, of which about 36% is for electricity generation, 30% for industrial uses, and the remaining 34% for household use. It is expected that in 2006 this will increase by about 542 million cm, of which about 76% of the increase will used for a planned increase in gas fired electric generation, 16 percent for additional use in industry, and about 8% for increased use by households. In 2007, a further increase of 842 million cm is expected, of which 81% will be for industrial uses, with about 12% for added electrical generation and 7% for increased use by households. In 2008 it is similarly expected that the further increased use of about 358 million cm will be primarily (about 70%) for industry, with about 16% for additional electric generation and 14% for increased household use.

Table 1: Current and Projected Gas Usage in Georgia
Gas Flow Forecasts, per MCC April 1 2005 Projections
On North South Pipeline
Sources of Consumption - Cubic Meters

Year	Electricity Generation	Industry	Households	Georgia Only	Transit to Armenia	Total
2005	528,144,000	430,000,000	500,000,000	1,458,144,000	1,700,000,000	4,616,288,000
2006	942,000,000	518,000,000	540,000,000	2,000,000,000	1,750,000,000	5,750,000,000
2007	1,042,000,000	1,200,000,000	600,000,000	2,842,000,000	1,800,000,000	7,484,000,000
2008	1,100,000,000	1,450,000,000	650,000,000	3,200,000,000	2,000,000,000	8,400,000,000

Forecasted Annual Changes in Consumption and Throughput

Year	Electricity Generation	Industry	Households	Georgia Only	Transit to Armenia	Total
2005						
2006	413,856,000	88,000,000	40,000,000	541,856,000	50,000,000	1,133,712,000
2007	100,000,000	682,000,000	60,000,000	842,000,000	50,000,000	1,734,000,000
2008	58,000,000	250,000,000	50,000,000	358,000,000	200,000,000	916,000,000
Total Change	571,856,000	1,020,000,000	150,000,000	1,741,856,000	300,000,000	3,783,712,000
Total Use	1,100,000,000	1,450,000,000	650,000,000	3,200,000,000	2,000,000,000	8,400,000,000

[1] Prepared by Paul Ballonoff, Chief of Party, CORE International USAID Project "Advisory Assistance to the Ministry of Energy of Georgia". Views expressed are only those of the author.

Table 2: Percentages of Georgian Current and Projected Gas Usage
Gas Flow Forecasts, per MCC April 1 2005 Projections
On North South Pipeline
Sources of Consumption - Percentages

Year	Electricity Generation	Industry	Households	Georgia Only	Transit to Armenia	Total
2005	36.22%	29.49%	34.29%	100.00%	116.59%	316.59%
2006	47.10%	25.90%	27.00%	100.00%	87.50%	287.50%
2007	36.66%	42.22%	21.11%	100.00%	63.34%	263.34%
2008	34.38%	45.31%	20.31%	100.00%	62.50%	262.50%

Forecasted Annual Changes in Consumption and Throughput

Year	Electricity Generation	Industry	Households	Georgia Only	Transit to Armenia	Total
2005						
2006	76.38%	16.24%	7.38%	100.00%	9.23%	209.23%
2007	11.88%	81.00%	7.13%	100.00%	5.94%	205.94%
2008	16.20%	69.83%	13.97%	100.00%	55.87%	255.87%
Total Change	104.46%	167.07%	28.47%	300.00%	71.03%	671.03%
Total Use	140.68%	196.56%	62.76%	400.00%	187.62%	987.62%

Table 3 on the next page summarizes the impacts of changes in cost if the same volumes as forecasted, were indeed those transacted. The entries for the year 2005, offers a base of comparison before analyzing impacts of projected changes in volumes. In 2005 at the present approximate price of $65, the cost of gas consumed in Georgia is about $94.8 million. If this had all been priced at the new price of $110, the cost would have been $160.4 million, thus the impact of the price increase on the current levels of consumption is about $65.6 million.

As noted, gas consumption has been forecasted to increase in 2006. At the new price, the increased cost for the total forecasted consumption in 2006 would be $90 million. Subtracting the $65.6 million impact on the present level of consumption, then the impact of the price increase on the increased volumes forecasted for 2006 is $24.4 million.

Looking at each sector, the distribution of those increases are as follows. In electricity, the increased cost for fuel on the current level of consumption is $23.8 million. The forecasted increased consumption in 2006 will add $18.6 million for a total fuel cost for electricity generation in 2006 of $42.4 million, with additional increases of about one-third that level in each of the following two years. In industry, the impact on current consumption is about $19.5 million, expected to increase by $about $4 million in 2006, with the largest impact from forecasted new consumption to occur in 2007 of $30.7 million, and in 2008 of a further added $11.3 million. For households, the effect on the current cost of consumption of about $32.5 million, is to add about $22.5 million annually. Expected growth in volumes will then add increments of $1.8 million in 2006, an additional $2.7 million in 2007, and another increment of $2.3 million in 2008.

Table 3: Comparative Impact of Projected Gas Cost Changes
Based on Gas Flow Forecasts, per MCC April 1 2005 Projections
On North South Pipeline

At Projected Price **New Price pe 1000 cu meters:**
Cost of Consumption $ 110.00

Year	Electricity Generation	Industry	Households	Georgia Only	Transit to Armenia	Total
2005	$ 58,095,840	$ 47,300,000	$ 55,000,000	$ 160,395,840	$ 187,000,000	$ 507,791,680
2006	$ 103,620,000	$ 56,980,000	$ 59,400,000	$ 220,000,000	$ 192,500,000	$ 632,500,000
2007	$ 114,620,000	$ 132,000,000	$ 66,000,000	$ 312,620,000	$ 198,000,000	$ 823,240,000
2008	$ 121,000,000	$ 159,500,000	$ 71,500,000	$ 352,000,000	$ 220,000,000	$ 924,000,000

Forecasted Annual Changes in Cost of Consumption and Throughput

Year	Electricity Generation	Industry	Households	Georgia Only	Transit to Armenia	Total
2005						
2006	$ 45,524,160	$ 9,680,000	$ 4,400,000	$ 59,604,160	$ 5,500,000	$ 124,708,320
2007	$ 11,000,000	$ 75,020,000	$ 6,600,000	$ 92,620,000	$ 5,500,000	$ 190,740,000
2008	$ 6,380,000	$ 27,500,000	$ 5,500,000	$ 39,380,000	$ 22,000,000	$ 100,760,000

At Previous Price **Old Price pe 1000 cu meters:**
Total Cost of Consumption $ 65.00

Year	Electricity Generation	Industry	Households	Georgia Only	Transit to Armenia	Total
2005	$ 34,329,360	$ 27,950,000	$ 32,500,000	$ 94,779,360	$ 110,500,000	$ 300,058,720
2006	$ 61,230,000	$ 33,670,000	$ 35,100,000	$ 130,000,000	$ 113,750,000	$ 373,750,000
2007	$ 67,730,000	$ 78,000,000	$ 39,000,000	$ 184,730,000	$ 117,000,000	$ 486,460,000
2008	$ 71,500,000	$ 94,250,000	$ 42,250,000	$ 208,000,000	$ 130,000,000	$ 546,000,000

Impact of Annual Changes in Throughput on Cost of Consumption

Year	Electricity Generation	Industry	Households	Georgia Only	Transit to Armenia	Total
2005						
2006	$ 26,900,640	$ 5,720,000	$ 2,600,000	$ 35,220,640	$ 3,250,000	$ 73,691,280
2007	$ 6,500,000	$ 44,330,000	$ 3,900,000	$ 54,730,000	$ 3,250,000	$ 112,710,000
2008	$ 3,770,000	$ 16,250,000	$ 3,250,000	$ 23,270,000	$ 13,000,000	$ 59,540,000

Increment in Cost of Consumption Due to Increased Volume and Increased Price
New Vs Previous Price
Increment in Price pe 1000 cu. m.: $ 45.00

Year	Electricity Generation	Industry	Households	Georgia Only	Transit to Armenia	Total
2005	$ 23,766,480	$ 19,350,000	$ 22,500,000	$ 65,616,480	$ 76,500,000	$ 207,732,960
2006	$ 42,390,000	$ 23,310,000	$ 24,300,000	$ 90,000,000	$ 78,750,000	$ 258,750,000
2007	$ 46,890,000	$ 54,000,000	$ 27,000,000	$ 127,890,000	$ 81,000,000	$ 336,780,000
2008	$ 49,500,000	$ 65,250,000	$ 29,250,000	$ 144,000,000	$ 90,000,000	$ 378,000,000

Increment in Cost Due to Price Effects Only on Incremental Volume

Year	Electricity Generation	Industry	Households	Georgia Only	Transit to Armenia	Total
2005						
2006	$ 18,623,520	$ 3,960,000	$ 1,800,000	$ 24,383,520	$ 2,250,000	$ 51,017,040
2007	$ 4,500,000	$ 30,690,000	$ 2,700,000	$ 37,890,000	$ 2,250,000	$ 78,030,000
2008	$ 2,610,000	$ 11,250,000	$ 2,250,000	$ 16,110,000	$ 9,000,000	$ 41,220,000

Part I.B. Comparative Impacts

The relative importance of the projected increase in gas cost might be measured by several indices, summarized in Table 4 below. As a percentage of current gross domestic product, the cost increase is about 1 percent. It is a bit less than 4% of the projected 2004 national budget. If it were all allocated to domestic accounts, it would be from about 1 percent to about 19.5% of the possible comparisons listed in the table.

The third block on the table compares the direct consumption of each of the three sectors identified in Table 1, converted to Lari, as a percentage of selected indices: as a percentage of total estimated 2006 consumer expenses (0.38% of the amount reported in the second block), as a percent of total estimated 2006 Private Investment (1.02% of the amount reported in the second block), and as a percent of 2004 estimated total cost of wholesale electricity production (19.87% of the amount estimated separately). However, the Government has also announced that it will pay that portion of the electricity cost increase for winter deliveries, from the budget, and not increase the wholesale electricity price, for at least a two month period. Within the gas sector, retail prices for households are already at or above the new price of $110. Thus, depending on how the GNERC treats the change in cost, the primary impact will be on gas prices to industry, whose wholesale component should presumptively rise by $45 per 1000 cm.

Table 4: Comparisons Of Relative Impacts

	Increment In Gas Cost Lari, Million	As % of:
Total Impact On Consumption Levels as of 2005	118.11	
GDP, Nominal Total, Forecasted 2006	12,878.50	0.92%
GoG Budget Expenses, Forecasted 2006	3,020.30	3.91%
Compared to Domestic Accounts, Forecasted 2006		
Consumer expenses	10,542.64	1.12%
Government	1,253.40	9.42%
Private	9,289.24	1.27%
Investments	4,017.53	2.94%
Government	610.17	19.36%
Private	3,407.37	3.47%
Export	4,676.72	2.53%
Import	6,358.34	1.86%
Impact By Sector, over Forecasted 2005		
Increase For Households, as % of Consumer Expenses:	40.50	0.38%
Increase for Industry, as % of Private Investment	34.83	1.02%
Increase For Electricity Production Cost	42.78	19.87%
Compared to WEM Cost, 2004 of	215.35	

Part II. Gas Cost Impact on Power Sector Strategic Analysis

The imminent increase in price of natural gas emphasizes the necessity for Georgia to undertake more comprehensive strategic analysis of options for development of the energy sector. We can illustrate this with a simple comparison, of the incremental costs per kwh of output, of new thermal power, import power, and new hydro power construction. Superficially, hydro power is very capital intensive, but of course also has no ongoing energy consumption cost for production of electricity. First, we note the obvious fact that increased cost of natural gas as a fuel increases the cost of production of electricity by a gas generation unit. Below we compare hydro to typical capital cost and operating assumptions for a gas fired generation unit. As shown there, the average cost per kwh of gas fired generation is about 4.48 tetri/kwh when gas price is $65, and becomes 5.93 tetr per kwh when the price is $110. The current import price for electricity is about 5.22 tetri/kwh. Clearly, therefore, on the assumptions of the attached tables, if the import price for electricity remains constant, before the gas price increase it was cheaper to generate domestically from imported gas, whereas after, it would be cheaper to import electricity and not generate from gas units domestically.

More subtle but of strategic importance, is the relationship to construction of new hydro-power capacity. The table below shows that if gas price remains high, it may be much cheaper to construct new hydro than to construct domestic gas fired generation. We explain the assumptions behind this result following the table.

Cost Comparison: Cost per kwh of possible sources	Tetri/kwh
New Thermal	0.0614
Imports	0.0522
New Hydro	0.0492

The principal assumptions of this comparison, apart from cost of natural gas, are on total capital cost per 100 MW of capacity (the sum of return on equity, cost of debt, income tax on return to equity and annual depreciation), the percentage cost of capital, and the means of recovery of capital (principally, period of depreciation). The cost of borrowed capital (debt) and of equity can be combined into one measure, the weighted average cost of capital, as illustrated in this next table, where equity requires 15% return, debt cost 5% (perhaps a concessionary rate from an international institution), and equity and debt are used in equal proportion. In that example the weighted average cost of capital is 10%.

Weighted Average Cost of Capital:	%	Rate	Wt. Average
Equity	50%	15%	7.500%
Debt	50%	5%	2.500%
Total	100%		10.000%

Consider first the cost for construction and fuel use of a typical thermal gas fired plant. We assume a cost of $100,000,000 per 100MW, a heat rate of conversion of 10,000 btu per kwh produced, and a plant operating factor of 50%. This last implies a use of near base load for half of the year, whereas more limited use of thermal, typical in Georgia, would reduce the output and thus increase the relative capital cost per kwh consumed. This fact may be somewhat offset by the use of the generic heat rate of 10,000; newer units may be more efficient, but older ones much less efficient. We also use a 10% weighted average cost of capital, and a 30 year depreciation term.

Cost Per kwh of New Thermal Generation Gas @ $110

Equivalent Fuel Cost Per kwh		
price per 1000 cm	$	110.00
cost for 1 BCM	$	110,000,000
fuel cost for generation per 100 MW at	$	17,184,752
kwh output per 100 MW capacity		876,000,000
fuel cost per kwh of energy	$	0.0196
Lari/$ exchange rate		1.8
fuel cost in Lari/KWH		0.0353

Average Annual Capital Cost/kwh		
Capital Cost/100 MW	$	100,000,000
Depreciation term		30
Average Annual Depreciation	$	3,333,333
Rate of Return, post tax		15%
Average Annual Equity	$	50,000,000
Average Annual Return	$	7,500,000
Income Tax Rate		20%
Tax Due	$	1,875,000
Average Total Annual Capital Cost	$	12,708,333
Average Capital Cost $/KWH	$	0.0145
Average Capital Cost Lari/KHW		0.0261

Total Cost Tetrri/kwh		0.0614
Total Cost S/kwh	$	0.0341

For hydro power capacity cost we used an estimate of Khudoni construction of 639 MW at a total cost of $700,000,000, or $111,111,111 per 100 MW. The numerical example below shows the result when we use 30 year amortization (depreciation of the total cost of construction, and a 50-50 mix of capital and debt at costs of 15% and 5% respectively.

New Hydro Relative Cost Comparison

Capital Cost per kwh of new hydro		
Khudoni MW		630
Annual Plant Factor		30%
Khudoni Annual KWH Output		1,655,640,000
KWH Output/100 MW Capacity		262,800,000
Khudoni Life, years		40
Projected Cost, total	$	700,000,000
Cost/100 MW	$	111,111,111
Depreciation term		30
Average Annual Depreciation	$	3,703,704
Rate of Return, post tax		10%
Average Annual Equity	$	55,555,556
Average Annual Return	$	5,555,556
Income Tax Rate		20%
Tax Due	$	(2,083,333)
Average Total Annual Capital Cost	$	7,175,926
Average Capital Cost $/KWH	$	0.0273
Average Capital Cost Lari/KHW		0.0492

In the following table, we compare the effect on total hydro power capital cost per kwh of output, using capital sources that consist of from 0% debt (that is, all equity) to 100% debt (no equity), and a range of depreciation amortization periods (20, 30 and 40 years). The table gives the first year cost per kwh produced under each of the 15 resulting scenarios:

Cost of 15 Scenarios of New Hydro Construction, Tetri/kwh

	Depreciation Period, Years		
Debt %	**20**	**30**	**40**
0%	0.1094	0.0967	0.0904
25%	0.0826	0.0700	0.0636
50%	0.0618	0.0492	0.0429
75%	0.0470	0.0343	0.0279
100%	0.0381	0.0254	0.0190

Notice that 8 of these 15 scenarios cost less than new thermal and also cost less than imports. The value in the middle of the table, of 4.92 tetri/kwh for new hydro, is that used in the above comparison table. This however is by no means the lowest in this table, and indeed, all 8 of the mentioned entries are that price or lower. These lower cost entries assume that debt is at least half of the capital structure, and include depreciation periods from 20 to 40 years.

Finally, note that in all comparisons, we omit operating costs (costs other than fuel, depreciation, interest on debt, return on capital, and income taxes). Inclusion of those costs would tend to further bias the result against the use of thermal plants.

Conclusion

This brief analysis, a first look at the effect of natural gas price increases, also shows that a comprehensive review of strategic energy alternatives can have a very great benefit to Georgia. Georgia need not be dependent on uncontrollable variations in fuel supplies from limited numbers of suppliers. The key to determine whether and if so what, options may exist, is a comprehensive review of strategic choices.